EXPERIENCE GAINED IN EMPLOYING THE PEDOLOGICO-FLORISTIC METHOD OF PROSPECTING UNDER CONDITIONS PREVAILING IN THE STEPPE PROVINCES BEYOND THE URALS

D. P. Malyuga

"Experience Gained in Employing the Pedologico-Floristic Method of Prospecting Under Conditions Prevailing in the Steppe Provinces Beyond the Urals"

D. P. Malyuga (Institute of Geochemistry and Analytical Chemistry imeni V. I. Vernadskiy, Acad Sci USSR)

/NOTE: The following appeared in the regular "Geochemistry" section of the thrice-monthly 'Doklady Akademii Nauk SSSR', Volume 76, No 2 (11 January 1951), pages 231-3./

Academician V. A. Obruchev often remarked on the possibility of exploiting soils and vegetation during prospecting for ore beds.(1) This possibility could also be deduced from the classical works by V. I. Vernadskiy on biogeochemistry, in which he pointed to the strong interrelation between inorganic and organic nature. The most important link in this relation is the continuous interchange of chemical elements-atoms.

It was indicated in the works by A. P. Vinogradov and by many other Russian scientists that during the abrasion process of ores and rocks diffused aureoles of one or other chemical elements (geochemical provinces) are formed. The diffused auroles often reach the earth's surface and influence soils, natural waters and vegetation. This forms the basis of the biochemical, pedologico-floristic method of prospecting for metals. (4,5).

The purpose of this work is to give a detailed analysis of the pedologico-floristic search method for searching for nickel, cobalt, chrome and other deposits under conditions of the steppe province.

The investigation performed by us is one of many examples of the application of the method of correlations of chemical elements in the solution of geochemical problems. Here it was established that in soils and plants taken over, underlying nickel, cobalt, chrome or cuprous deposits, the relations between Ni, Co and other ferrous elements vary sharply, which represents one of the characteristic signs of the presence of mineralization.

In the present case we generalize the experience gained during our work to districts containing nickel-silicate ores.

They belong in time to the ancient weathering crust of ultra-fundamental rocks, ultrabasite (serpentine rocks). The depth of deposit of nickel-containing weathering zones is not considerable, which certainly contributed to the establishment of relation in the chemical composition of these ores, soils, and plants. The thickness of the strip, it was found, does not effect the relative abundance of nickel in soils, at least if it does not exceed 20 m.

We faced the problem of checking the pedologico-floristic method of prospecting. As a result of the work performed some advantages of the pedologido-floristic method were revealed, because this method does not necessitate complicated technical equipment and may be performed rather simply and rapidly; namely, by an accelerated method of analyzing soils and plants.

In contrast to the usual rectangular network of testing, we draw from one point a bundle of radially diverging lines, so that they crossed at several spots the boundaries of mineralized zones. Along these lines samples of soil and plants are taken, beginning every 100 m from the initial point, later every 50 m and finally every 25 m. Data of soil analysis taken along of one of these lines is shown in Table 1.

It follows from Table 1 that the nickel content fluctuates between $7.9 \cdot 10^{-3}$ to $3.6 \cdot 10^{-1}$ %. Samples of soil taken within this area on gabbro-amphibolites (No 35) and in the interval between them and the mineralized area (Nos 36, 37) revealed a minimum nickel content. In correspondence with the contoúur and geological profile of the deposits, the maximum nickel content in the soil was observed in samples taken over nontronite, whose depth of deposit varies from 5 to 12 M. In this case the cobalt content is closely correlated to nickel. However, the cobalt concentration in soils is always 10 to 12 times lower than that of nickel. This is a characteristic sign of the presence of a nickel mineral, because the usual ratios Co:Ni in soils seldom exceed 1 : 3 (see reference 4). In contrast to Ni and Co, the copper content differs little from the familiar average quantity Clark number which is well illustrated by ratios and "Clarks numbers of concentration" of cobalt, nickel and copper in soils. Thus, if the relative concentration of copper seldom exceeds the number 5, cases are known where nickel concentration exceeds the "soil Clark" by a factor of ten. Here is the first indication of the chemical composition of underlying nickel-bearing deposits.

Therefore the content and distribution of Co, Ni and Cu in the soil investigaged characterize the nickel meneralization of the part under study.

All that has been said above is completely confirmed by numerical data, obtained by analysis of the soils in the remaining profiles.

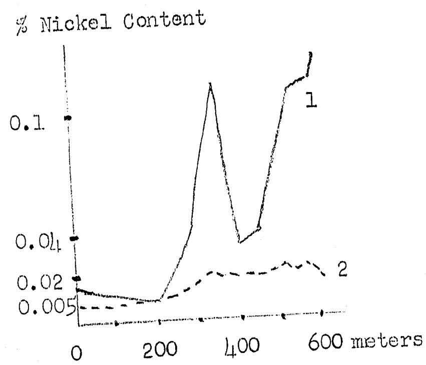
To check the correlation of nickel content in the biogeochemical ore-soil-plants profiles, the nickel content (Co, Cu) in plants was studied. Figure 1 compares the analysis data on the ashes plant "Linosyris villosa Benth et Hook' with nickel content in soils, taken suitably from the samespots of the profile. It may be seen from Figure 1 that the nickel concentration in plants reflects sufficiently well the increase of its content in the soils. This enables one to use plants together with soils for the purpose of prospecting by the pedologico-floristic method.

On the basis of actual data already gathered we conclude that under circumstances of arid steppes or similar conditions the pedologico-floristic method may be employed for the practical prupose of prospecting.

But this method requires in each separate case the consideration of physico-geographical and geological conditions of the specified region.

BIBLIOGRAPHY

1. V. A. OBRUCHEV, Field Geology [Polevaya Geologiya], 1 Moscow - Leningrad: 1932.
2. V. I. Vernadskiy, Biogeochemical Descriptions, 1922 - 1932 [Biogeo-khimicheskiye Ocherki, 1922 - 1932], Moscow - Leningrad (Acad Sci USSR): 1940.
3. A. P. VINOGRADOV, DAN 18, No 4-5 (1938).
4. S. M. Tkalich, Messenger of the Far-Eastern Affiliate of Acad Sci USSR [Vestnik Dalnevostochnogo filiala AN SSSR], No 32 (5), Vladivostok: 1938.
5. D. P. Malyuga, Priroda, No 6, 14 (1947).



Distance from the cut (profile) on gabbro

Figure 1. Nickel content: 1 - in soils
2 - in plants.

Table 1

Content of Co, Ni, Cu in Soils taken along One Line

Characteristic of Soil	Nos of samples	Content of elements in soils in % Co	Ni	Cu	Ratio Co:Ni:Cu	Concentration relative to Clark Co	Ni	Cu
Average (Clark) in soils	-	$1.0 \cdot 10^{-3}$	$4.0 \cdot 10^{-3}$	$2.0 \cdot 10^{-3}$	1:4:2	-	-	-
Bright chestnut, solonets, argillaceous soil. Initial point 22 on kaolinized gabbro-amphibolites	35	$3.0 \cdot 10^{-3}$	$1.3 \cdot 10^{-2}$	$8.0 \cdot 10^{-3}$	1:4.3:2.7	3	3	4
Solonets of deep structure, argillaceous. Point 100 m from the initial point	36	$2.4 \cdot 10^{-3}$	$9.0 \cdot 10^{-3}$	$8.7 \cdot 10^{-3}$	1:3.75:3.7	2.4	2.2	4.3
Solonets ordinary, argillaceous. Point 200 m from initial point	37	$1.9 \cdot 10^{-3}$	$7.9 \cdot 10^{-3}$	$8.1 \cdot 10^{-3}$	1:4.1:4.2	1.9	2	4
Solonets of deep structure argillaceous, Point 300 m from initial	38	$3.0 \cdot 10^{-3}$	$4.3 \cdot 10^{-2}$	$1.2 \cdot 10^{-2}$	1:14:4	3	10	6
Solonets of deep structure argillaceous. Point 350 m from initial	39	$2.1 \cdot 10^{-2}$	$2.1 \cdot 10^{-1}$	$1.0 \cdot 10^{-2}$	1:10:1.4	21	50	5
Solonets ordinary, argillaceous. Point 400 m from initial	40	$4.2 \cdot 10^{-3}$	$3.0 \cdot 10^{-2}$	$6.6 \cdot 10^{-3}$	1:7.1:1.5	4.2	7.5	3.3
Solonets ordinary, argillaceous. Point 450 m from initial	41	$4.5 \cdot 10^{-3}$	$4.0 \cdot 10^{-2}$	$9.5 \cdot 10^{-3}$	1:9:2.1	4.5	10	4.7

- -

Solonets ordinary, agrillaceous. Point 500 m from initial	42	$6.7 \cdot 10^{-3}$	$7.4 \cdot 10^{-2}$	$8.75 \cdot 10^{-3}$	1:11:1.3	6.7	18	4.4
Solonets ordinary, agrillaceous. Point 525 m from initial	43	$1.2 \cdot 10^{-2}$	$1.5 \cdot 10^{-1}$	$7.2 \cdot 10^{-3}$	1:12.5:0.6	12	37.5	3.3
Soil ~~dark chestnut~~ ordinary, agrillaceous. Point 550 m from initial	44	$1.5 \cdot 10^{-2}$	$2.0 \cdot 10^{-1}$	$1.9 \cdot 10^{-2}$	1:13:1.3	15	50	9.5
Soil dark chestnut agrillaceous. Point 575 m from initial	45	$1.55 \cdot 10^{-2}$	$2.1 \cdot 10^{-1}$	$1.3 \cdot 10^{-2}$	1:13.5:0.9	15.5	52	6.5
Soil dark chestnut argillaceous. Point 620 m from initial.	46	$2.0 \cdot 10^{-2}$	$3.6 \cdot 10^{-1}$	$1.2 \cdot 10^{-2}$	1:18:0.6	20	90	6

Declassified in Part - Sanitized Copy Approved for Release 2012/04/11 : CIA-RDP82-00039R000200030012-4